Regional Wave Propagation in New England and New York: Collaborative Research with Boston University and Tufts University

Grant No. 04HQGR0167

Rachel E. Abercrombie

Associate Professor, Department of Earth Sciences

Boston University, 685 Commonwealth Avenue

Boston, MA 02215

617-358-2571, 617-353-3290 (FAX), rea@bu.edu

Laurie G. Baise

Assistant Professor, Department of Civil and Environmental Engineering

Tufts University, 113 Anderson Hall

Medford, MA 02155

617-627-2211, 617-627-3994 (FAX), laurie.baise@tufts.edu

Gisela Fernandes

Graduate Student Researcher, Department of Earth Sciences

Boston University, 685 Commonwealth Avenue

Boston, MA 02215

gmvf@bu.edu

Key words: Wave Propagation, Source Characteristics, Regional Seismic Hazards

Annual Project Summary

December 1, 2004

Investigations Undertaken:

We are using regional recordings of the largest, well-recorded earthquake in the northeastern USA to characterize its source process and model regional wave propagation in New York and New England. On 20 April 2002, a M_W5.0 earthquake occurred in northern New York state near the town of Au Sable Forks. This earthquake is the largest to occur in New England since installation of the current broadband network, and hence is the best recorded earthquake in the Northeast USA. The ground motions recorded during this earthquake provide a unique opportunity to study earthquake rupture and wave propagation in New England. In the past, ground motion studies in New England have been severely limited because of the scarcity of good recordings. The Au Sable Forks earthquake was well-recorded by 11 broadband stations in New England and over 40 others in New York and southeastern Canada. We are using ground motions recorded on four different seismic networks in the US and Canada.

Over the project duration we will perform a study of the Au Sable Forks earthquake and the ground motions it produced. Our research involves two tasks:

- *Determine the source process of the 20 April 2002 Au Sable Forks Earthquake.* Using the aftershock recordings we will develop empirical Green's functions in order to invert for the mainshock source process and slip distribution.
- *Develop and validate a crustal model for wave propagation in the region.* We will use one-dimensional wave propagation from the source to the stations in New York and New England. Two-dimensional crustal structure will be investigated if time permits.

To date, we have collected and processed the seismic data for the Au Sable Forks earthquake. Currently, we are addressing several data processing issues that have been identified. A major geologic boundary exists just east of the Au Sable Forks epicenter between the Appalachian and Grenvillian provinces. The Appalachian province is to the east of the epicenter and primarily underlies New England whereas the Grenvillian province primarily underlies New York State. Separate 1D models are therefore being developed independently for the Appalachian and Grenvillian provinces. We have assembled several existing one-dimensional crustal models from the literature for the Appalachian and Grenvillian provinces. We are in the process of creating synthetics for each of our stations using a frequency-wavenumber approach to compute Green's functions for each one-dimensional velocity structure (Saikia, 1994). Our initial effort is focused on the New England region (Appalachian province) where we are comparing the synthetics to the recorded data. Next we will repeat this analysis for the New York region (Grenvilleian province). In addition, we are collecting two-dimensional reflection and refraction seismic data of the region. The data are being assembled into a common dataset using GIS and will be used to evaluate the three-dimensional nature of the crustal structure.

Results:

The results to date are preliminary and limited in scope. In general, the initial synthetics that have been developed using published 1-D crustal models for the Appalachian province roughly match the recorded data in terms of arrival times and general shape when lowpassed at 1 Hz.

Reports published:

We have not published any reports to date.

References:

Saikia, C.K. (1994). Modified Frequency-Wavenumber Algorithm for Regional Seismograms using Filon's Quadrature: Modelling of Lg Waves in Eastern North America. *Geophys. J. Int.* **118**, 142-158.

Non-technical Summary:

On 20 April 2002, a M_W5.0 earthquake occurred in northern New York state near the town of Au Sable Forks. This earthquake is the largest to occur in New England since installation of the current broadband network, and hence is the best recorded earthquake in the Northeast USA. The ground motions recorded during this earthquake provide a unique opportunity to study earthquakes and wave propagation in New England. We will use regional recordings of the largest, well-recorded earthquake in northeastern USA to characterize the earthquake source and model regional wave propagation in New York and New England. In the past, ground motion studies in New England have been severely limited because of the scarcity of good recordings.